

Space Weather Technical Forecast

Issued on Friday, 17 December 2021 at 12:04 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Daily Chance (35%) of M-class flares, potentially increasing later in period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar Activity has been Moderate in the last 24 hours, with an impulsive M1.2 at 17/0051 UTC originating from the newest region, AR2911, in the northeast quadrant.

There are currently six sunspot regions on the visible disc. AR2905 has now decayed. AR2906 has shown slight decay. The largest and most complex group of sunspots is a cluster constituted of AR2907, AR2908 and AR2909, located in the southeast quadrant. Two of these regions, AR2907 and AR2908 are classified as Beta-gamma. AR2907 appears to be coalescing into three main spot portions, with the lead spot group showing some recent slight decay. AR2908 continues to show some minor spot emergence. AR2909 appears relatively stable. AR2910 shows some additional minor spot emergence. The newly numbered AR2911, which has recently developed toward the northeast limb, has shown consolidation in its lead spot and some waxing/waning of its small trailer spots.

No Earth-directed Coronal Mass Ejections (CMEs) were observed in available satellite imagery for the period, although several peripheral eastern horizon events were noted, as well as very faint and narrow west limb occurrences.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by the DSCOVR satellite, gradually decreased from 550 to 400 km/s, with average density levels. The Total IMF (Bt) was weak throughout, with the north-south component (Bz) only showing brief and weak southward orientations. Phi angle was mainly in the negative solar sector (toward the Sun). Resultant geomagnetic activity was Quiet (Kp 0 to 2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels. The high energy electron flux (greater than 2 MeV) was at mainly Background levels, with the associated 24-hour integrated fluence well below the Active threshold. A fluence of 2.03e6 was observed at 17/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to continue mainly Low, with the chance (35%) of further isolated M-class flares, and a very slight (5%) chance of an X-class flare. Flare probabilities may increase a little looking ahead in the coming days, with further potential active regions likely to rotate around the east limb.

Solar Wind / Geomagnetic Activity: No CMEs feature in the current forecast period. Solar winds have dropped to near background levels following recent coronal hole influence. With no other significant coronal holes expected in the forecast period, similar conditions are expected to prevail. Geomagnetic activity is therefore expected to be mainly Quiet with isolated Unsettled

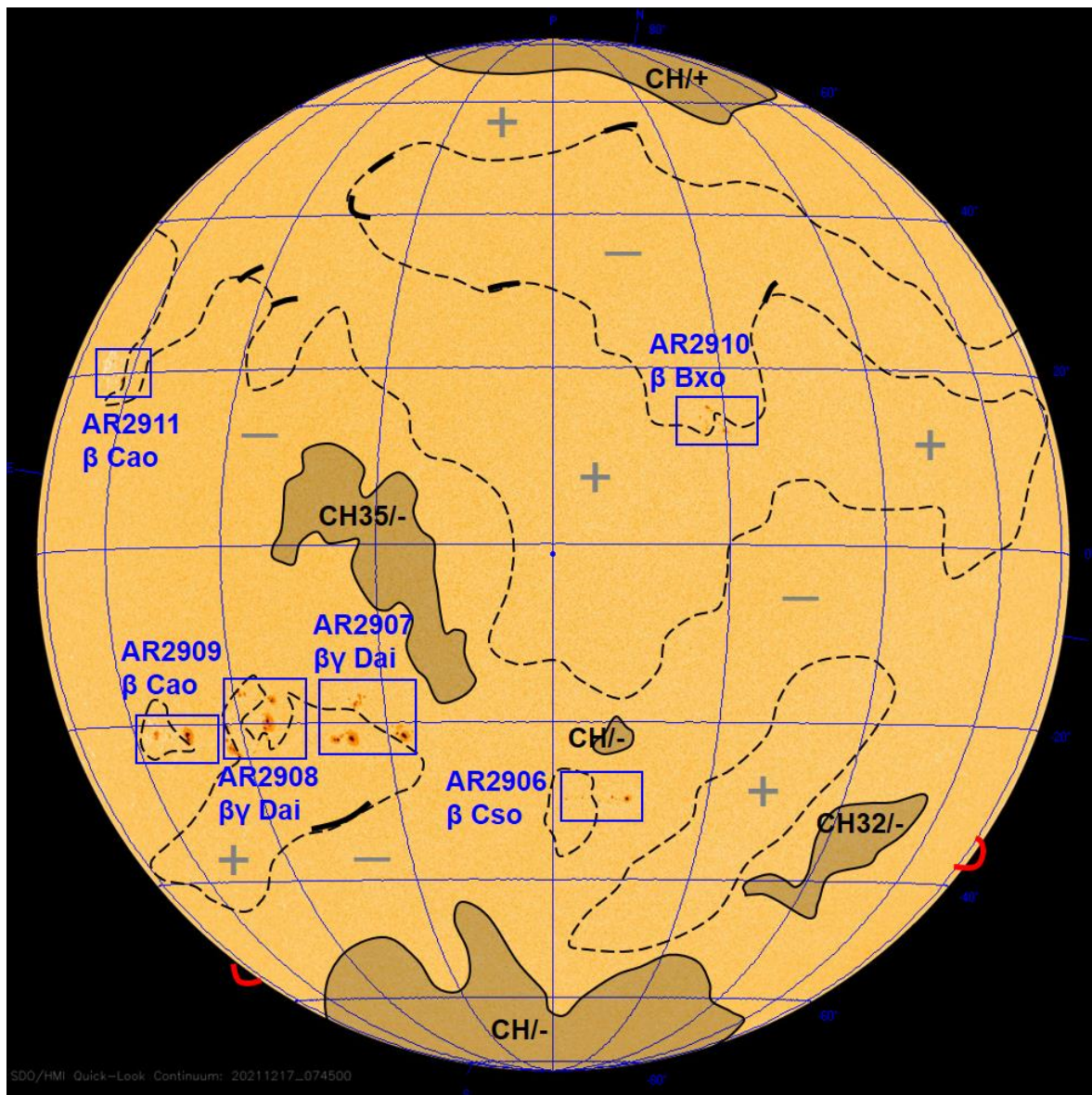
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intervals.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels, although with a slight increasing risk as the active regions transit towards the western hemisphere.

The high energy (greater than 2 MeV) electron flux, as observed by GOES-16, is expected to be at Background to Moderate levels, perhaps with a slight rising trend in the next day or so. The associated fluence is expected to remain below the Active threshold, again perhaps with a slight rising trend.

Figure 1. Solar Analysis Valid 17/0800 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

No Earth-directed CMEs feature in this forecast.

Solar winds have dropped to near background levels following recent coronal hole influence. With no other significant coronal holes expected in the forecast period, similar conditions are expected to prevail.

Geomagnetic activity is therefore expected to be mainly Quiet with isolated Unsettled intervals.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Radio Blackouts - X-Ray Flares:

Solar Activity has been Moderate in the last 24 hours, with an impulsive M1.2 at 17/0051 UTC originating from the newest region, AR2911, in the northeast quadrant. The cluster of sunspot regions in the southeast quadrant also maintain the potential for a significant flare given their collective complexity. Solar activity is expected to continue mainly Low, with the chance (35%) of further isolated M-class flares, and a very slight (5%) chance of an X-class flare.

The prospects for significant flare activity may increase a little further looking ahead in the coming days, with Stereo A EUVI imagery indicating further potential active regions likely to rotate around the east limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	35	35	40	40
Very Active	R3 to R5 X Class	No	5	5	10	10

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently expected to remain at Background levels.

Increasing sunspot activity may warrant a slight increase in the chance of S1 radiation storms over the next few days, though at present the most significant active regions are in the eastern hemisphere of the solar disc. As a result any large flares are less likely to cause Solar Radiation Storms at Earth.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	2	3	4	5
Very Active	$\geq \text{S3}^*$	No	1	1	1	1
* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)						

High Energy Electrons Event ($\geq 2 \text{ MeV}$):

The high energy (greater than 2 MeV) electron flux, as observed by GOES-16, is currently at Background to Moderate levels. Following the waning influence of CH32 electron flux may rise over the next day or so, but no rising trend is apparent at the moment. Therefore, high flux levels seem unlikely at present.

The latest REFM model does show a forecast gradual rising trend in fluence over the next 72 hours, and while this is expected to hold true in general, it is currently significantly over-estimating fluence levels. REFM is considered to be more a reflection of what happened on the last rotation and therefore considered not particularly useful guidance at this time. Fluence is expected to remain below the Active threshold.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV} \geq 1 \times 10^8$	No	1	10	20	20
Very Active	$\geq 2 \text{ MeV} \geq 1 \times 10^9$	No	1	1	1	1

Figure2: Latest REFM output.

